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I Don't Like it Because it Eats Sprouts: Conditioning Preferences in Children

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## Abstract

Although little is known about how preferences develop in childhood, work in adults suggests that evaluative responses to stimuli can be acquired through classical conditioning. In two experiments children were exposed to novel cartoon characters, that were either consistently paired with a picture of a disliked food (Brussels sprouts) or a liked food (ice cream). Relative preferences for these stimuli (and others) were measured before and after these paired presentations (Experiment 1): preferences for the cartoon character paired with Brussels sprouts decreased, whereas preferences for the character paired with ice cream increased. These preferences persisted after 10 un-reinforced trials. Experiment 2 replicated this finding using affective priming as an index of preference for the cartoon characters. These findings demonstrate that preferences to novel stimuli can be conditioned in children and result from associations formed between the stimulus and a stimulus possessing positive or negative valence.

Keywords: Evaluative Conditioning, Children.

## 1. Introduction

Preferences influence all aspects of human behaviour; they impact upon the foods we eat, the products we buy, the stimuli we approach or avoid and the people with whom we spend time. Evaluation of stimulus valence is so fundamental that Lang, Bradley and Cuthbert (1990) have proposed that the brain uses it as a basic category for organizing information and activating approach or avoidance behaviours. Stimulus evaluation is also thought to be immediate, unintentional and linked to behavioural responses (Duckworth, Bargh, Garcia & Chaiken, 2002).

A vast array of work has looked at changing stimulus evaluations in adults. The question of how preferences can be manipulated has attracted interest from diverse areas of psychology (see De Houwer, Thomas & Baeyens, 2001, for a review): social psychology (e.g. Olson & Fazio, 2001; Staats & Staats, 1958), cognitive psychology and learning (e.g. Baeyens, Crombez, Van den Bergh, & Eelen, 1988; Baeyens, Eelen & van den Burgh, 1990; Field & Davey, 1997; Hermans, Vansteenwegen, Crombez, Baeyens, & Eelen, 2002), consumer psychology (e.g. Shimp, Stuart & Engle, 1991; Stuart, Shimp & Engle, 1987) and clinical psychology (e.g. Lascelles, Field & Davey, 2003, Schienle, Stark, & Vaitl, 2001). Although the terminology sometimes differs, essentially these branches of psychology have all found some support for the notion that preferences can be changed through Classical conditioning (known as evaluative conditioning, EC). The idea is simple: if an evaluatively neutral stimulus (a conditioned stimulus, CS) is presented contingently and contiguously with a stimulus that already possesses a strong negative or positive valence (an Unconditioned Stimulus, US), then the valence of the CS will shift in the direction of the US with which it was paired.

In theoretical terms, EC, like classical conditioning, is thought to be mediated by associations in memory between the CS and a representation of the US. However, unlike classical conditioning, EC is believed to occur without awareness of CS-US contingencies (e.g. Baeyens et al., 1990; Olson & Fazio, 2001 but see Field, 2000) and appears to be resistant to extinction (e.g. Baeyens et al., 1988; Diaz, Ruiz & Baeyens, 2005). This has led some to believe

that the CS-US associations formed are merely referential connections between stimuli, so unlike classical conditioning the CS need not be accompanied by a genuine expectancy that the US will follow (Baeyens, Eelen & Crombez, 1995).

However, the conditioning of evaluations has been a controversial phenomenon. There have been methodological debates in the social psychology (see Page, 1974), consumer (see Darley & Lim, 1993) and learning (see Davey, 1994; Field & Davey, 1999; Shanks & Dickinson, 1990) literatures. For example, recent controversy regarding EC stems from both failures to obtain the basic effect (e.g. Field, Lascelles & Davey, 2003; Rozin, Wrzesniewski & Byrnes, 1998; Field and Davey, 1999) and demonstrations that EC-effects can be elicited through non-associative processes (Field & Davey, 1997, 1999). Davey (1994) pointed out that because some EC paradigms using visual stimuli do not include non-paired control conditions against which to compare conditioning effects, there is little evidence that the effects observed are due to CS-US associations being formed. In addition, true conditioning effects can be isolated only if the pairing of a particular CS with a particular US is counterbalanced across participants (Shanks and Dickinson, 1990) and this has not always been done. To infer a causal role for 'associations' in the change of preferences, a Popperian view of science dictates that conditions in which the cause is present (in this case associations are present) must be compared with situations in which the cause is absent (associations are absent). A condition is needed in which CSs and USs are presented, but associations between them cannot be formed. As yet, few studies using visual stimuli have incorporated such strict methodologies.

Childhood is undoubtedly a prime period for developing preferences (if only because as age increases the proportion of novel stimuli in the environment decreases) and Eagly and Chaiken (1993) have alluded to the importance of studying developmental aspects of attitude formation. However, relatively little is understood about how stimulus evaluations develop in childhood: the scant research available shows only that pre-school children show no preference towards abstract or realistic paintings (McGhee & Dziuban, 1993), or 'hard' or 'soft' tactile stimuli (Curry & Exner, 1988), but tend to prefer novelty (Bradbury & Moscato, 1983; Bradbury, Shewfelt &

Gjerek, 1984), have little overlap with their mothers in the evaluative criteria they use for brand preferences (Bahn, 1987), and that pre-adolescent girls tend to prefer thinner body shapes (Collins, 1990). All of these studies have relied on simply showing children stimuli and measuring a preference in some way. As such, they do not address how these preferences develop: merely that they exist. Based on the adult literature, classical conditioning seems a good bet for a mechanism; however, although there is evidence that flavour preferences in children can be conditioned using fat content or caloric density (Birch, McPhee, Steinberg, Sullivan, 1990; Johnson, McPhee, & Birch, 1991), attempts to condition preferences using visual stimuli in children have failed (Macklin, 1986). In Macklin's study, coloured pencils (orange or yellow) were used as CSs and a (pre-tested) picture of a Smurf was used as a positive US. One pencil was paired with the US for a given child (so the two pencils were counterbalanced across the US). Children were exposed to only three CS-US pairings (over a 20 minute period) in which a poster depicting one of the pencils was shown with a poster of the Smurf. There were three conditions: in a simultaneous conditioning condition the posters were held up simultaneously, in a forward conditioning condition, the CS poster was held up immediately followed by the Smurf poster, and in an unpaired control condition the CS and US posters were held up individually at approximately even breaks over a 20 minute period. After conditioning the children were asked to select either a yellow or orange pencil as a reward for their participation. In all conditions, the number of children selecting pencils congruent with the colour of pencil associated with the positive Smurf US was virtually identical to the number selecting a pencil of incongruent colour. There are many problems with this study: first, there were relatively few CS-US pairings, the presentation of pairings was naturalistic and so exposure times were not controlled, it is not clear from the write up that the pencil not paired with the US was presented at all to act as a control for exposure, and the conditioning trials were embedded in another task. The purpose of the current experiments is to develop a paradigm to test unequivocally whether stimulus evaluations can be conditioned in children.

## 2 Experiment 1

### 2.1 Method

#### 2.1.1 Participants

Thirty-nine children (18 male, 21 female) aged 9 to 11 years ( $M = 136.10$  months,  $SD = 4.59$ ) participated. The experimental group contained 10 males and 11 females and the control group contained 8 males and 10 females. The mean age of the experimental group ( $M = 135.81$  months,  $SD = 4.73$ ) was comparable ( $t(37) < 1$ ) to that of the control group ( $M = 136.33$  months,  $SD = 4.55$ ). All children were recruited from a local primary school.

#### 2.1.2 Stimulus Materials

Novel cartoon characters, about which the children had no prior experience, were created for this experiment<sup>i</sup>. These cartoon characters were called 'Futuremons'. Six Futuremons (see appendix A) out of an initial set of 17 were selected based on a pilot study on 10 children (5 male and 5 female aged 8 to 11 years): the two images most consistently ranked around the middle of the sample were chosen to be the neutral CSs, the highest and lowest ranked characters and the characters ranked at approximately 25% and 75% in the sample were also picked. The CSs were named 'Andimon' and 'Helemon' so children could identify them. A different sample of 10 children (5 males and 5 females aged 7 to 10 years) rated the 6 chosen pictures on a 200 point visual analogue scale ranging from -100 (dislike the Futuremon) through 0 (neutral) to +100 (like the Futuremon) in intervals of 5. The mean ratings of Andimon and Helemon were 3.00 ( $SD = 17.98$ ) and -6.5 ( $SD = 19.44$ ) respectively, which were not significantly different,  $t(9) = 1.68$ . The remaining pictures received mean ratings (in ascending order) of -41.00, -22.00, 19.50 and 63 ( $SDs = 35.57, 37.87, 41.53$  and  $38.38$ ).

Two USs were used that had consistent valence across UK children (Brussels sprouts as a disliked stimulus and Ice Cream as a liked stimulus). Initially 6 pictures were chosen (3 of Brussels Sprouts and 3 of Ice Cream). The 10 children who initially rank ordered the 17 Futuremons rated these pictures on a 200 point visual analogue scale ranging from -100 (dislike

the picture) through 0 (neutral) to +100 (like the picture) in intervals of 5. The most negatively ( $M = -60.00$ ,  $SD = 40.55$ ) and positively ( $M = 92.00$ ,  $SD = 15.49$ ) rated pictures were selected as USs.

### 2.1.3 Procedure

The whole procedure was run on a Toshiba Tecra laptop PC running Windows 2000 using software custom written in Visual basic by the author.

*Stage 1 (Pre-conditioning CS Ratings):* Ratings of the futuremons were obtained using a rating procedure similar to that used by Johnsrude, Owen, Zhao, & White, (1999). This procedure was chosen in preference to the standard 200-point visual analogue scale (described above) typically used in EC research because it conceals from the participant the ratings they have given. This was deemed important because of speculation that memory for pre-conditioning ratings could both explain some failures to obtain EC and imply that some successes have been merely demand characteristics (see Field, 2005 a). To get ratings of the Futuremons, a pair of Futuremons appeared on the screen (one on the left and the other on the right) and the child was required to click on the Futuremon that they preferred. Upon clicking one of the Futuremons the next randomly-selected pair appeared. Each of the 6 Futuremons was presented alongside each of the other 5 Futuremons twice: once appearing on the left and once appearing on the right. Each Futuremon, therefore, appeared 10 times in total (and each child saw 30 pairs). Each time a Futuremon was clicked it received a score of 1 and so by the end of the trials each Futuremon had a score ranging from 0 (it was never selected as the preferred Futuremon) though 5 (it was selected as the favourite on half of its presentations) to 10 (it was always preferred).

*Stage 2 (The Conditioning Stage):* Shanks and Dickinson (1990) and Field & Davey (1999) have stressed the importance of counterbalancing CSs and USs across participants to rule out artifactual explanations of EC results. Therefore, in this study, children were split into two groups: For half of the children 'Andimon' was allocated to be paired with the negative US (Brussels sprouts) and 'Helemon' was paired with the positive US (Ice cream); for the other

group, these allocations were reversed. Within each of these groups approximately half of the children were assigned to an experimental group and half to a Block/Sub-block control condition (Field's, 1996, BSB Control – described below).

All children were shown an instruction screen that had labelled pictures of the two CSs ('Andimon' and 'Helemon') and instructions below that read "The two monsters above are very special: one is called Andimon and the other Helemon. In the next few minutes you'll be shown lots of monsters on the screen, but we want you to look out for Andimon and Helemon. As the monsters appear on the screen sometimes you will see a picture of what that monster likes to eat. It is important that you look out for what the monsters like to eat and think about whether you like eating those foods as well."

The experimental group were then shown a series of conditioning trials in which a CS (the picture of Andimon or Helemon) appeared on the screen either on the left or right of the screen (randomly determined) and at a random vertical alignment; after 1 second the appropriate US appeared on the opposite side of the screen at a random vertical alignment<sup>ii</sup> and both CS and US remained on the screen for 2 seconds. The screen then went blank for an inter-trial interval (ITI) that varied randomly between 2 and 4s. Each CS-US pair appeared 10 times. In addition, each of the remaining 4 Futuremons appeared during the conditioning stage on 4 occasions. These Filler stimuli had no USs and merely appeared in a random location on the screen for the same time as the CSs (3 seconds) before the ITI. The order of all presentations was random but with the restriction that a pair involving a particular Futuremon CS could not be shown on more than 2 consecutive occasions.

The BSB control group experienced the same CSs and USs as above except that the CS and US presentations were separate (so the CS could not be associated with the US). So, a CS appeared on the screen alongside an image of itself for 5 trials followed by similar presentations of the other CS (this is a *CS block*). Next the Futuremons that had no US appeared 4 times each in random order (this is the *filler block*). Then a US appeared on the screen alongside an image of itself for 5 trials before a similar block presentation of the other US paired with itself (the *US*



block). For a given child the order of the CS block and US block was determined randomly, but for all children these blocks were separated by the filler block<sup>iii</sup>. The BSB control is slightly preferable to a standard random control in EC because of the possibility of one-trial learning in EC (see Field, 1996).

*Stage 3 (post-conditioning CS Ratings):* Following the conditioning (or BSB) procedure, the children again rated the Futuremons using the same procedure as described in stage 1.

*Stage 4 (Extinction):* In the extinction phase the two CSs were again presented 10 times each in random order (again the same CS could not appear more than twice consecutively) but without their associated USs. On a given presentation, the CS appeared on the screen for 3s, followed by an ITI defined as for the conditioning stage.

*Stage 5 (post-extinction CS Ratings):* Following the extinction procedure, the children again rated the Futuremons using the same procedure as in stages 1 and 3.

*Stage 6 (UCS ratings):* Finally, children were presented with the two US pictures (in random order) above an on-screen rating scale that ranged from -100 (dislike) through 0 to + 100 (like). They dragged a pointer along this scale to indicate how much they liked or disliked the two US pictures.

### 3 Results

Throughout this paper results are reported at  $p < .05$  unless otherwise stated. Where an effect size is interpretable, it is reported as  $r$  (see Field, 2005b).

#### 3.1 US Ratings

A 2 (US Type: Brussels sprouts vs. Ice cream)  $\times$  2 (Group: experimental vs. BSB control) mixed ANOVA with US type as the repeated measure revealed a highly significant effect of US Type,  $F(1, 37) = 149.60$ ,  $p < .001$ ,  $r = .90$ , indicating that Brussels sprouts were rated significantly lower ( $M = -50.85$ ,  $SE = 9.02$ ) than ice cream ( $M = 79.69$ ,  $SE = 4.16$ ). The group

effect,  $F(1, 37) < 1$ ,  $r = .07$ , and the group  $\times$  US type interaction,  $F(1, 37) < 1$ ,  $r = .01$ , were not significant. Both groups regarded the positive US as positive and the negative US as negative.

### 3.2 CS Ratings

In the experimental group, the evaluation of the CS paired with the liked US increased after conditioning whereas the evaluation of the CS paired with the disliked US decreased (Figure 1). The acquired responses did not extinguish after 10 presentations without the US. This pattern was not seen in the control group.

Insert Figure 1

A 2 (US Type: Brussels sprouts vs. Ice cream)  $\times$  3 (time: pre-conditioning, post-conditioning, post-extinction)  $\times$  2 (Group: experimental vs. BSB control) mixed ANOVA with US type and time as repeated measures was conducted. The assumption of sphericity was violated for the main effect of time,  $W = 0.80$ ,  $\chi^2(2) = 7.95$ , so Greenhouse-Geisser corrected degrees of freedom were used for this effect.

The only significant effects were the main effect of US type,  $F(1, 37) = 5.17$ , and the crucial US type  $\times$  time  $\times$  group interaction,  $F(2, 74) = 5.30$ ,  $p < .01$ . This indicates that changes in CS ratings over time depended both on the US with which a CS was paired and the group to which children belonged. To tease this effect apart, 3 (time: pre-conditioning, post-conditioning, post-extinction)  $\times$  2 (Group: experimental vs. BSB control) mixed ANOVAs were conducted separately for each CS. For the CS paired with the liked US, the Time  $\times$  group interaction was significant,  $F(2, 74) = 3.32$ . Contrasts on this interaction revealed that relative to the control group, CS ratings in the experimental group increased significantly from pre- to post-conditioning,  $F(1, 37) = 4.52$ ,  $r = .33$ , but there was no significant change from post-conditioning to post-extinction,  $F(1, 37) < 1$ ,  $r = .04$ . For the CSs paired with disliked USs, the Time  $\times$  group interaction was significant,  $F(2, 74) = 4.29$  and contrasts on this interaction revealed that relative to the control group, CS ratings in the experimental group decreased

significantly from pre- to post-conditioning,  $F(1, 37) = 7.28$ ,  $r = .41$ , but there was no significant change from post-conditioning to post-extinction,  $F(1, 37) = 1.84$ ,  $r = .22$ .

One issue is that at preconditioning the control group's preferences for CSs paired with different types of US differed somewhat. However, a two-way 2 (group: experimental vs. control)  $\times$  2 (US type: liked vs. disliked) mixed ANOVA on preconditioning ratings revealed no overall differences between ratings of CSs paired with different USs,  $F(1, 37) = 2.85$ , no overall significant difference between the preconditioning preferences across group,  $F(1, 37) < 1$ , and no significant US type  $\times$  group interaction,  $F(1, 37) = 2.55$ . This indicates that the differences in preconditioning ratings between different CSs and across conditions were statistically comparable.

A final issue is whether the changes observed in the control group are significant. Separate (time: pre-conditioning vs. post-conditioning)  $\times$  2 (US type: liked vs. disliked) repeated measures ANOVAs in each group revealed a significant US type  $\times$  time interaction,  $F(1, 20) = 7.75$ , but no significant main effects of US Type,  $F(1, 20) = 2.66$ , or Time,  $F(1, 20) < 1$  in the experimental group. However, in the BSB control group there was no significant US type  $\times$  time interaction,  $F(1, 17) = 2.35$ , or main effects of US Type,  $F(1, 17) = 2.75$  or Time,  $F(1, 17) = 3.84$ . This indicates that changes in CS ratings were significant in the experimental group, but not in the control group.

These results confirm the preferences for novel cartoon characters could be changed through classical conditioning. The fact that CSs were counterbalanced across USs and the use of a BSB control also provide unequivocal evidence that these changes were due to associations formed between the CS and US and were not due to nonassociative processes such as those described by Field & Davey (1999), or stimulus properties (Shanks & Dickinson, 1990).

### *3.3 Ruling out Alternative Explanations*

One possible problem with the way in which CS ratings are obtained is that it does not measure ratings of one CS independent of the other (because two of the trials require

participants to directly select a preference for one CS over the other). Therefore, the resulting preference ratings include the relative preference of the two CSs. As such, the changes in CS preference after conditioning may simply reflect children switching their preference of the two CSs. For this to explain the results it would need to be true that the CS that was eventually to be paired with the disliked US received a higher preference score than the CS that was to be subsequently paired with the liked US before conditioning. Therefore, in counterbalancing order 1, Andimon would have to be preferred to Helemon pre-conditioning, and in counterbalancing order 2 Helemon should be preferred to Andimon, pre-conditioning. Table 1 shows that this is not the case. This table shows the number of children preferring Andimon to Helemon and vice versa (and those for whom the preference scores for Andimon and Helemon were equal) across all experimental conditions. In all conditions there is a tendency to prefer Andimon over Helemon. This was confirmed by a backward elimination loglinear analysis on these frequencies (see Field, 2005 b) in which counterbalancing order (order 1 or 2), preferences at preconditioning (Helemon preferred over Andimon, equal scores or Andimon preferred over Helemon), group (experimental vs. control) and all of the respective interactions between these variables were entered. All main effects and interactions were nonsignificant except for the main effect of preference at preconditioning,  $\chi^2(2)$  change if effect deleted = 6.90. This reflects the fact that across all groups the 'Andimon preferred to Helemon' contained more observations than the other two categories<sup>iv</sup>.

The fact that in general Andimon was more often preferred to Helemon rules out the possibility that the results simply reflect the two CSs changing position in the rank order. However, this explanation could still be valid in the counterbalancing order in which Andimon was paired with the negative US. What is more, the overall results could simply reflect a strong conditioning effect in this counterbalancing order and no effect in the other. To investigate this possibility, the main ANOVA on the CS ratings was re-run but including counterbalancing order as an additional between-group factor. The pattern of results was the same as previously reported, and no effects involving the counterbalancing order were significant (in particular, the crucial

counterbalancing  $\times$  US type  $\times$  time  $\times$  group interaction was non-significant,  $F(2, 70) = 1.16$ ). In addition, the effect sizes for the conditioning effect when the counterbalancing orders were analysed separately were comparable at  $r = .31$  for the Andimon-Disliked US group and  $.28$  for the Andimon-Liked US group. These effect sizes are not significantly different,  $z = 0.09$ .

## 4 Experiment 2

Experiment 1 is the first attempt to demonstrate evaluative learning in a child sample. It is also one of few studies to utilise stringent controls for associative processes. However, one obvious criticism is that the use of direct measures of preferences may have contributed to the results. Given the simplicity of the contingencies, and despite the use of filler presentations during conditioning, it is possible that the children picked up the contingencies, especially given that the instructions explicitly drew attention to the contingencies of conditioning. Children could have then guessed the purpose of the experiment and when making their post-conditioning evaluations attempted to respond to the demands of the task. Although the way in which evaluations were elicited goes against this explanation (the children would be unlikely to know exactly what evaluation they had given because they merely compare pairs of Futuremons), the second Experiment attempted to replicate the finding by using an indirect measure of preference: the affective priming task (Fazio, Sanbonmatsu, Powell, & Kardes, 1986). In this task, positive or negative target stimuli are presented, which have to be rapidly evaluated as either 'positive' or 'negative'. However, each target is immediately preceded by a positive, negative, or neutral prime stimulus, which has to be ignored by the participant. Response times to targets are significantly smaller if it is preceded by an evaluatively congruent prime, compared to when it is preceded by response an evaluatively incongruent prime. This effect is based on the automatic processing of the valence of the prime; therefore, it does not depend on controlled response strategies, which makes it an excellent and unobtrusive method to assess newly acquired preferences that is not easily biased by demand characteristics (Hermans, De Houwer, & Eelen, 2001; Hermans et al., 2002).

## 4.1 Method

### 4.1.1 Participants

Fifty-eight children (31 male, 27 female) aged 7 to 9 years ( $M = 102.58$  months,  $SD = 20.71$ ) participated. The experimental group contained 16 males and 21 females and the control group contained 15 males and 6 females. The mean age the experimental group ( $M = 100.05$  months,  $SD = 18.07$ ) was comparable ( $t(56) = -1.11$ ,  $ns$ ) to that of the control group ( $M = 105.91$  months,  $SD = 21.52$ ). Thirty-seven children (25 experimental and 12 controls) were recruited from a local primary school and 21 (12 experimental, 9 controls) were visitors to the Science Museum, London in which the experiment was set up as part of their 'live science' programme.

### 4.1.2 Procedure

The procedure was essentially the same as Experiment 1 except that an affective priming task was used as the measure of evaluative responses to the CSs. This task, arguably, provides a measure of affective responses that is uninfluenced by conscious attempts to conform to demands of the task (see Field, 2005a). As with Experiment 1, the whole procedure was run using software custom written in Visual basic by the author.

*Stage 1 (Pre-conditioning CS Ratings):* Ratings of the Futuremons were obtained in the same way as Experiment 1. These data were not initially intended for analysis but merely to familiarise the children with the cartoon characters. However, the data do provide information about the initial valence of the CSs.

*Stage 2 (The Conditioning Stage):* This stage was identical to Experiment 1.

*Stage 3 (Affective priming):* Following the conditioning (or BSB) procedure, the children took part in an affective priming task. In this task, 6 'nasty' words (bad, cry, dead, hate, sad, sick) and six 'nice' words (good, happy, joy, love, pretty, smile) were used as targets. The major criterion for selecting these words was that 7-9 year old children could easily read them and knew their evaluative meaning (this was known from prior work by the authors in which these words were used as part of a similar measure: Field & Lawson, 2003). Each word was presented

4 times: twice with the 'negative' CS (the CS paired during conditioning with the negative US) as its prime and twice with the 'positive' CS (the CS paired during conditioning with the positive US) as its prime. As such, there were 48 trials in all: 24 congruent trials (a negative CS primes a negative word or a positive CS primes a positive word) and 24 incongruent trials (a negative CS primes a positive word or a positive CS primes a negative word). If children regarded the CS paired with the negative US as less likeable than the CS paired with the positive CS then this should be revealed by significantly slower response times to incongruent trials relative to congruent trials. Children were given 12 practice trials before the main affective priming task. On a given priming trial, a fixation cross appeared in the centre of the screen for 500ms before the prime (one of the two CSs) was flashed on the screen for 200ms followed by an interstimulus interval of 100ms in which the screen was blank. Finally, one of the targets appeared (a nice or nasty word) and remained on the screen until the child identified the target by pressing either 'A' on a keyboard for a nice word or 'L' for a nasty word. Reaction times were measured from the onset of the target to the key press and if the response was incorrect an error was logged, a red cross appeared on the screen and the child had to give the correct response to carry on. The interval between priming trials was 2 seconds. These parameters were chosen based on Hermans et al. (2001) and advice from an affective priming expert (D. Hermans, personal communication, 17th October, 2002).

*Stage 4 (UCS ratings):* Finally, children rated the USs as described in Experiment 1.

## 4.2 Results

Ratings of the USs were analysed as before. A highly significant main effect of US Type was found,  $F(1, 56) = 943.06$ ,  $p < .001$ ,  $r = .97$ , indicating that Brussels sprouts were rated significantly lower ( $M = -46.76$ ,  $SE = 8.34$ ) than ice cream ( $M = 74.88$ ,  $SE = 5.40$ ). The main effect of group,  $F(1, 56) < 1$ ,  $r = .01$ , and the group  $\times$  US type interaction,  $F(1, 56) = 1.44$ ,  $r = .16$ , were not significant.

For the reaction time data, trials in which children incorrectly identified the target were excluded, and a standard deviation based cut-off was used (see Ratcliff, 1993): for each child, reaction times greater than 2 standard deviations above or below their mean were excluded. A mean reaction time for congruent and incongruent trials was calculated for each child. Following Olson and Fazio (2001), an affective priming score was then calculated by subtracting the mean reaction time for congruent trials from the mean reaction time for incongruent trials. A positive score represents a conditioning effect (the CS paired with the liked US is regarded as more positive than the CS paired with the disliked US), a score of zero shows no difference in preference to the CSs, and a negative score means that the CS paired with the disliked US is preferred over the CS paired with the liked US. Figure 2 (bars) shows that a significant priming effect was observed in the experimental group compared to the control,  $t(56) = 1.68$ ,  $r = .22$ . One-sample  $t$ -tests revealed that the priming effect in the experimental group,  $t(36) = 2.16$ ,  $r = .34$ , but not in the control group,  $t(20) < 1$ ,  $r = .07$ , was significantly different from zero. Figure 2 (lines) shows the difference in errors made on congruent and incongruent trials. The groups did not differ,  $t(56) < 1$ ,  $r = .02$ , indicating that in both conditions a similar amount of errors were made on congruent and incongruent trials (hence a difference close to zero).

These results show that the CS paired with the liked US was preferred over the CS paired with the negative US as indexed by an affective priming task. In the experimental group, congruent trials were performed faster than incongruent trials, but this was not true in the control group. Furthermore, this finding cannot be explained by differences in the number of errors made across the two groups.

The discovery of a priming effect in the experimental group demonstrates that CSs paired with liked and disliked stimuli evoked US-congruent affective reactions. In addition, the fact that no such effect was found in the control group shows that the affective reactions must be due to a CS-US association being formed (because this is the only respect in which the two groups differ). Given that CSs were counterbalanced across USs it is hard to see how any other explanation is justified. Nevertheless, an analysis of the initial preferences was done to verify



that before conditioning the CSs were rated roughly neutrally. A 2 (CS: Andimon vs. Helemon)  $\times$  2 (Group: experimental vs. control) ANOVA revealed a main effect of CS: as in Experiment 1, Andimon was preferred over Helemon,  $F(1, 56) = 5.28$ ,  $r = .29$ . There was no main effect of group,  $F(1, 56) = 1.25$ ,  $r = .15$ , and crucially, a nonsignificant group  $\times$  CS interaction,  $F(1, 56) < 1$ ,  $r = .11$ . This means that CS ratings in the experimental group,  $M_{\text{Andimon}} = 5.95$  ( $SEM = 0.40$ ),  $M_{\text{Helemon}} = 4.62$  ( $SEM = 0.42$ ), were comparable to those in the control,  $M_{\text{Andimon}} = 6.19$  ( $SEM = 0.53$ ),  $M_{\text{Helemon}} = 5.57$  ( $SEM = 0.56$ ). In all cases the means of the CSs were around the middle of the 10 point scale. Also, as in Experiment 1, an analysis was done to see whether preferences for CSs paired with different types of US differed before conditioning. A two-way 2 (group: experimental vs. control)  $\times$  2 (US type: liked vs. disliked) mixed ANOVA on preconditioning ratings revealed no overall differences between ratings of CSs paired with different USs,  $F(1, 56) < 1$ , no overall significant difference between the preconditioning preferences across group,  $F(1, 56) = 1.25$ , and no significant US type  $\times$  group interaction,  $F(1, 56) = 3.08$ . This shows similar results to Experiment 1: the differences in preconditioning ratings between different CSs and across conditions were statistically comparable.

## 5 General Discussion

In Experiment 1, directly-measured preferences to novel cartoon characters were conditioned in a group of children, and in Experiment 2, this finding was replicated using an indirect measure of preference. In addition, the use of a control group in which CS-US associations could not be formed, and the counterbalancing of CSs across USs confirm that these changes were caused by an association being formed between each CS and the US with which it was paired. Experiment 1 also provided tentative support for the idea that conditioned evaluative responses may be resistant to extinction (Diaz et al., 2005). This is the first properly controlled demonstration of conditioned preference learning of visual stimuli in children. The findings from these experiments have wide implications for social, cognitive, consumer and developmental psychologists. First, they dispel some of the criticisms of other work in which control groups have not been used (e.g. Baeyens et al., 1988, 1990; Olson & Fazio, 2001) or in

which CSs have not been counterbalanced across USs (e.g. Baeyens et al., 1988, 1990). Along with other recent work (e.g. Diaz et al., 2005) this strengthens the case that it is possible to condition visual preferences. The paradigm developed also opens the door for developmental psychologists to better understand how preferences are acquired in childhood.

Failures to condition preferences (e.g. Field et al., 2003; Field & Davey, 1999; Rozin et al., 1988) have led to speculation about boundary conditions in evaluative learning (De Houwer et al., 2001). The current paradigm differs from some adult paradigms in several ways: first, preferences were always measured in a more indirect way than in many adult EC paradigms (which often employ explicit visual analogue rating scales); the number of contingencies (2) was more in keeping with autonomic conditioning paradigms than adult EC studies (in which up to 9 different CS-US pairs are used); CS and US presentations overlapped, rather than having an inter-stimulus interval as is common in EC research; there was a logical connection between the CS and US (the US represented the food eaten by the CS); and the CSs were stimuli about which children had no prior experience. Although none of these factors were systematically manipulated, they point towards possible boundary conditions that future work could investigate. In terms of Macklin's (1986) failure to condition preferences in children, the current study exposed children to CS-US pairs ten times rather than 3, there was some obvious connection between the CS and US, and explicit and implicit preference ratings were taken rather than a behavioural measure. Macklin's failure could be due to insufficient conditioning trials, or perhaps the preferences conditioned in the present study would not be strong enough to translate into a behavioural response. It is also possible that Macklin's children simply were not attending to the conditioning task because it was embedded in another unrelated task (and Field & Moore, 2005, have shown how divided attention can have detrimental effects on evaluative learning). Of course, it is also possible that the instructions within the current study prompted children to make associations and respond to task demands. However, the results from Experiment 2 rule out a demand characteristic explanation of the evaluative responses; even in this study though it is likely that the instructions prompted explicit associations to be formed.

Theoretically, the results are interesting in confirming that the CS-US association was the causal factor determining the acquisition of the preference. This makes an interesting contrast with Olson and Fazio (2001) who paired CSs with several USs of the same affective valence. The implication from their paradigm is that evaluations of the CSs changed because of an association with the *response* to USs (i.e. stimulus-response, S-R, learning). This implication is drawn from the fact that CSs did not consistently enter into associations with a specific US but did consistently enter into associations with a specific response to the USs. In the current study, a single US was used and the results represent stimulus-stimulus (S-S) learning. Associative learning in animals has come to be thought of in terms of S-S learning (Pearce & Bouton, 2001), and so Olson & Fazio's findings are intriguing because when taken with the current studies they imply that conditioned preferences can stem from both S-S and S-R learning. In which case, an interesting theoretical direction would be to explore whether these forms of preference learning differ (for example, one might not expect S-R learning to rely on awareness of specific contingencies, as Olson & Fazio found, whereas S-S learning might reasonably require this awareness).

One limitation of the current study is that the affective priming data are represented only as an overall score and so it is not clear whether the effect was driven by the negative primes, the positive primes or both. Although Olson and Fazio (2001) similarly report overall conditioning scores based on reaction times, future work would undoubtedly benefit from a more fine-grained analysis of the affective priming task to tease apart the effect that conditioning has had on the different priming trials.

In conclusion, this study has (1) shown that preferences towards novel stimuli can be conditioned in children; (2) demonstrated that these acquired preferences are caused by an association between the CS and the US with which it was paired; and (3) presented a paradigm in which this can be further explored. Along with other recent studies, this helps diffuse some of the cynicism surrounding EC using visual stimuli and better understand how preferences develop in childhood.

## 6 Acknowledgement

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## 7 Appendix A: Futuremons

8



**Andimon**



**Helemon**

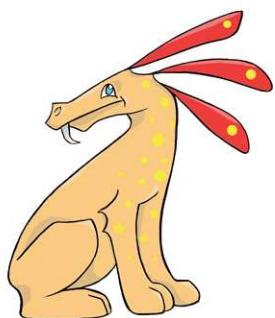
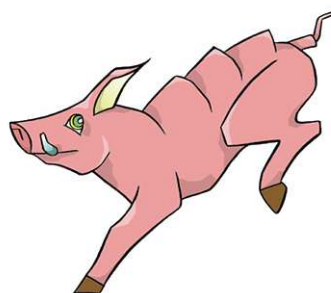


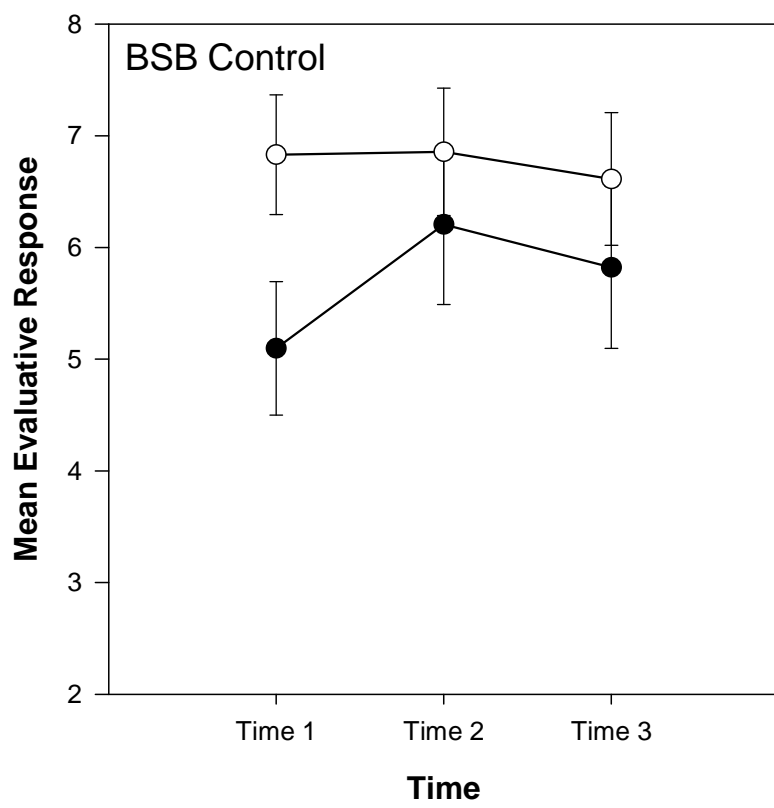
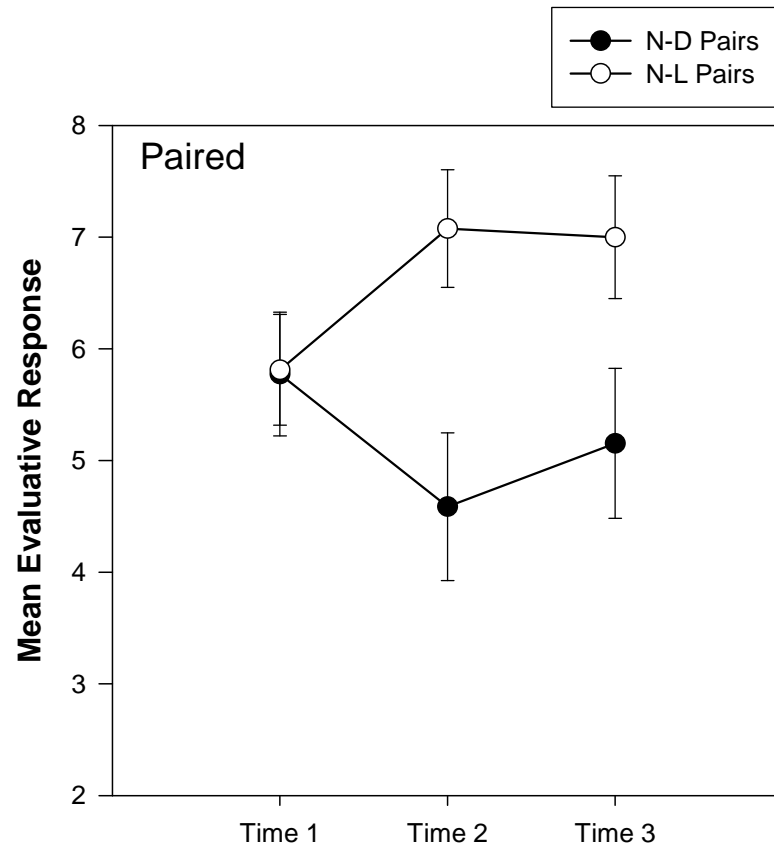


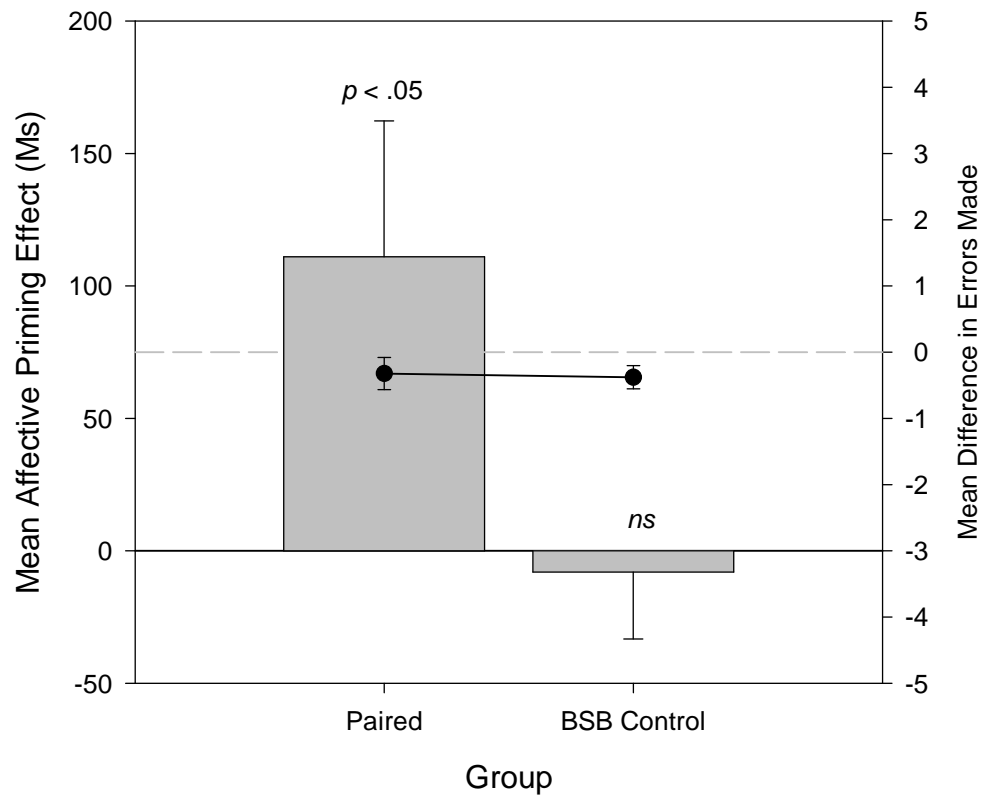
Table 1: Number of children preferring the two CS stimuli across groups

Group	Counterbalancing Order	CS Preference before conditioning			Total
		Helemon Preferred	Equal Scores	Andimon Preferred	
Experimental	Andimon-Liked US	2	3	6	11
	Helemon-Liked US	1	2	7	10
	Total	3	5	13	21
BSB Control	Andimon-Liked US	1	3	5	9
	Helemon-Liked US	5	1	3	9
	Total	6	4	8	18

## FIGURES

- Figure 1: Graph showing the mean preference (and standard error) for the Futuremon selected to be paired with a disliked (N-D) and liked (N-L) US at pre-conditioning (time 1), post-conditioning (time 2) and post-extinction (time 3) in the experimental and control group.
- Figure 2: Graph showing the mean affective priming effect (and standard error) for experimental and control groups. Bars represent the affective priming effect (response latency to incongruent trials - latency to congruent trials); the line chart shows the difference in the number of errors (errors on incongruent trials - errors on congruent trials).





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<sup>i</sup> These characters were created by Sunfish Handmade (<http://www.sunfish-handmade.fsnet.co.uk>).

<sup>ii</sup> These vertical alignments were such that a picture could appear at any vertical position on the screen within the constraint that the entire picture was visible on the screen.

<sup>iii</sup> This presentation schedule should control for the temporal and visual experiences of the child while preventing CS-US associations being formed. However, there is a slight anomaly: in the experimental group a CS appears for 3s on 10 occasions (30s in total), but in the BSB control they see 3 + 2s on 5 occasions (25s in total). Conversely, in the experimental group the USs are seen for 2s on 10 occasions (20s total), but in the control they are shown for 25s in total. Although this controls for the associations formed, it is only an approximate control for exposure times.

<sup>iv</sup> A simpler analysis would have been to recalculate the preference ratings without the two trials on which the CSs appeared on the screen together (creating a preference score out of 8 rather than 10). Unfortunately this analysis could not be done because the computer program recorded only how many times a particular Futuremon was selected as the preferred Futuremon across all trials: it did not retain information (such as which pair of Futuremons appeared) for individual trials.